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Early Evolution

Daniel Esler
The College at Brockport, mr.esler@gmail.com

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Lesson 2 – Part 1
Daniel Esler
July 2003

Early Evolution

Objectives

Upon completion of this lesson, students will:

- Have a better understanding of the characteristics of early Earth
- Have a better understanding evolution
- Be able to manipulate parameters in Agentsheets
- Be able to create spreadsheets in Excel

Materials/Tools Needed

Students will need access to a computer with AgentSheets and Microsoft Excel installed and a copy of the model "Evolution – Lesson 2."

Grouping/Target Audience

Work in groups of 2--for students in grades 7-9.

NYS Standards

Standard 1, #1 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.
Standard 1, # 2 Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.
Standard 2, # 1 Information technology is used to retrieve, process, and communicate information and as a tool to enhance learning.
Standard 2, #2 Knowledge of the impacts and limitations of information systems is essential to its effective and ethical use.
Standard 3, #4 Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.
Standard 3, # 6 Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.
Standard 4, #3 Individual organisms and species change over time.
Standard 4, #4 The continuity of life is sustained through reproduction and development.
Standard 4, #5 Organisms maintain a dynamic equilibrium that sustains life.
Standard 4, #6 Plants and animals depend on each other and their physical environment.
Standard 6, # 2 Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.

Standard 6, #4 Equilibrium is a state of stability due either to a lack of changes (static equilibrium) or a balance between opposing forces (dynamic equilibrium).

Topics Discussed: *Evolution, Probability, Anaerobic organisms vs. aerobic organisms, Competition, Fitness*

In this activity, students will observe the progression of the Agent Sheets' model "Evolution – Lesson 2." This model begins with the conditions of early Earth, a great deal of carbon dioxide and simple, anaerobic organisms. These organisms use up CO_2 and produce oxygen. Additionally, these organisms can spontaneously spawn a new species, an aerobic organism. These new organisms use O_2 and produce CO_2. A second type of aerobe can be spawned from the primary aerobic organisms that will out-compete the primary aerobe due to a slightly improved fitness. Of course, with the amount of randomness in the organisms' movement, the model can go in several different directions. This could lead to a number of different classroom discussions and lessons.

Lesson Outline

Focus and Review – This lesson focuses on the environment of early Earth. Students should be familiar with the early characteristics (high concentration of CO_2 and anaerobic organisms) of Earth. Students should also be familiar with the workings of Agentsheets and Microsoft Excel. This lesson uncovers the ideas of evolution. Although it is not necessary students are familiar with the ideas of evolution, a little brush up wouldn't hurt.

Objectives – Through this lesson, students will gain a better understanding of the interdependence of organisms and the creation of an environmental equilibrium. The setting for this lesson is early earth, when only carbon dioxide and anaerobic organisms ruled. Students will gain a better understanding of this developing environment, of evolution, of modeling software and randomness, and of designing spreadsheets.

Teacher Input – The teacher first needs to familiarize students with the conditions of early earth and with the software the students will be using, Agent Sheets. The teacher should also deliver insightful questions for students while the students are working with the software. An example of a suitable question is "What conditions could you change improve the chances of reaching equilibrium?"

Guided Practice – The teacher will guide students through running the Agentsheets program. The teacher will help students identify the worksheet as the environment of early Earth. The teacher will walk students through what should happen in the model. The class will then run the program on their own PCs. The model should be stopped when all of the organisms die or after a few minutes, whatever happens first. The teacher will also help students set up an Excel spreadsheet in which students will record their outcomes. After this initial trial and filling out the spreadsheet, the students will be free to continue with the activity without the teacher's input.

Independent Practice - Students will run many trials of the Evolution Model. They will run trials both before and after manipulating the parameters of the various organisms and create a spreadsheet from their collected data. From this, graphs and charts can be created and the most fruitful parameters (those that yield an equilibrium) can be discovered.

Closure - Through collected classroom data, the most realistic parameters (those that produced the best equilibrium) can be determined.